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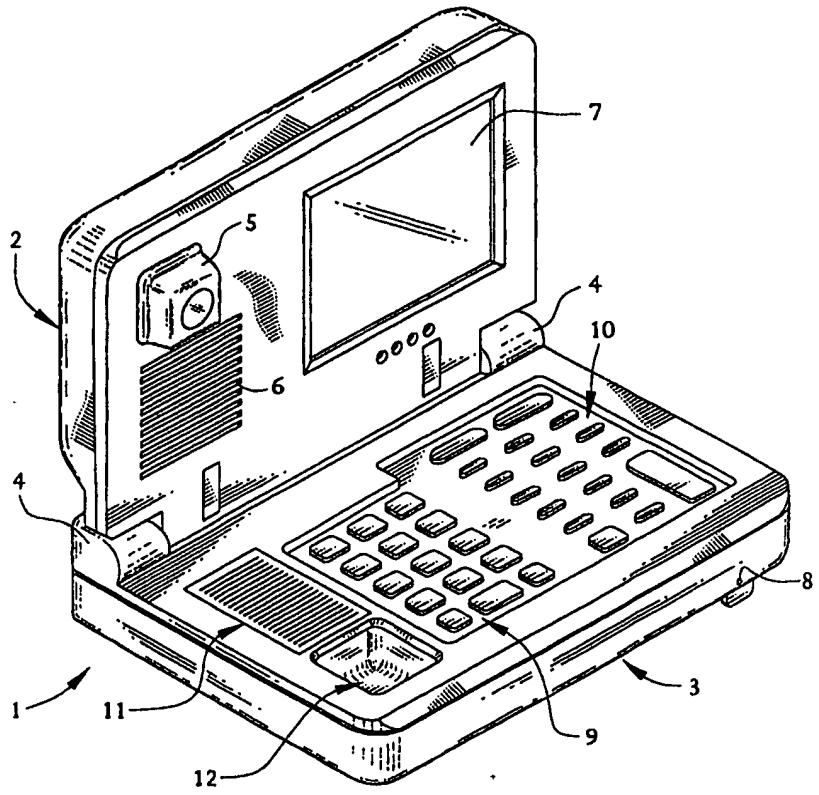
(54) Title: PORTABLE, STAND-ALONE VIDEO TELEPHONE SYSTEM

(57) Abstract

An independent, stand-alone video telephone capable of being integrated into a single, portable package includes a foldable case that contains the operative components needed for transmitting and receiving both voice and video images over a conventional telephone line. The respective half sections which comprise the case include a printed circuit assembly containing the communications and electronics suitable for operating the video telephone, a display, a color camera, a speaker-phone system and a telephone keypad unit which provide the necessary functions of a video telephone. The video telephone is fully compatible with present industry standards for the transmission of telephone signals, allowing communications between the video telephone and other video telephone products developed to the prevailing industry standards.



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PORTABLE, STAND-ALONE VIDEO TELEPHONE SYSTEM

Background of the Invention

The present invention relates generally to the field of video telephones, and in particular, to a video telephone that is both portable and capable of use as a stand-alone unit.

The overall concept, and recognized desirability of a telephone system that is capable of transmitting not only voice, but also images, has been known for some time. This applies not only to business applications, but also to general consumer applications. The impetus for such systems is a natural outgrowth of the desire, and in some cases the need to transmit information which would benefit from a visual display, in addition to the traditional transmission of voice signals over a telephone line.

To meet such needs, a variety of video telephone systems have been developed. However, the deployment of such systems has to date been relatively slow due to limitations such as cost and compatibility with existing telephone equipment. As a result, while video telephone systems have found a limited amount of acceptance in the business community, such as in video conferencing and the like, the widespread deployment of video telephone equipment is not yet common-place, and has not yet significantly penetrated the general consumer markets.

It has therefore remained desirable to develop a video telephone system which is sufficiently simple, cost-effective and compatible with conventional telephone systems and equipment to meet the foregoing demands.

Summary of the Invention

It is therefore a primary object of the present

invention to provide a cost-effective video telephone system which can operate as a stand-alone unit.

It is also an object of the present invention to provide a stand-alone video telephone system which is portable, and capable of convenient deployment for use.

It is also an object of the present invention to provide a portable, stand-alone video telephone system which is compatible with existing telephone switch systems and equipment.

It is also an object of the present invention to provide a portable, stand-alone video telephone system which is cost-effective, easy to use, and well suited to a wide variety of business and consumer applications.

These and other objects which will become apparent are achieved in accordance with the present invention by providing an independent, stand-alone video telephone which is capable of being integrated into a single, portable package. To this end, the video telephone of the present invention is packaged in a foldable case that contains the operative components needed for transmitting and receiving both voice and video images over a conventional telephone line, which will typically include a printed circuit assembly containing the communications and electronics suitable for operating the video telephone, a display (e.g., a 4 inch diagonal color TFT LCD module), a color (e.g., CCD) camera, a speaker-phone system and a telephone keypad unit.

The resulting video telephone is made fully compatible with present industry standards for the transmission of telephone signals, in this way allowing communications between the video telephone and other video telephone products developed to the prevailing industry standards. The video telephone of the present invention is well suited for use over standard (analog POTS) telephone lines, which represent one of the most commonly deployed subscriber telephone networks in use.

For a further discussion of the video telephone of the

present invention, reference is made to the detailed description which is provided below, taken in conjunction with the following illustrations.

Brief Description of the Drawings

Figure 1 is an isometric view of a video telephone produced in accordance with the present invention, shown from the front of the unit.

Figure 2 is a side elevational view of the video telephone of Figure 1, in a closed configuration.

Figure 3 is an isometric view of the video telephone of Figure 1, shown from the rear of the unit.

Figure 4 is a block diagram showing the various system components which comprise the video telephone of the present invention.

Detailed Description of a Preferred Embodiment

Figure 1 illustrates a video telephone 1 produced in accordance with the present intention. The video telephone 1 is generally comprised of a pair of half sections 2, 3, which are mutually joined by hinges 4. As shown in Figure 2, the half sections 2, 3 and the hinges 4 which joins them combine to develop an outer enclosure for the video telephone 1 which is book-like or box-like in general configuration, and which is substantially rectangular in cross-section. In this way, the case of the video telephone 1 presents a narrow, convenient profile. In an opened position, when ready for use, the half section 2 can assume any of a variety of angles relative to the half section 3, responsive to user comfort and convenience. This angle is preferably limited to 120°, responsive to limiting structures associated with the hinge 4.

It is to be understood that the configuration shown for the video telephone 1 is only one of a number of

configurations which could be used to achieve a similar result, and which would offer similar convenience for the user. A suitable latching mechanism (not shown) can be used to maintain the half sections 2, 3 in a closed position when the video telephone 1 is not in use.

As shown in Figure 1, the uppermost half section 2, which serves as the top for the video telephone 1, includes a series of operative components including a camera 5 for acquiring video images, a speaker 6 for producing audible sound and a video display 7 for producing video images, as will be discussed more fully below.

The lowermost half section 3, which serves as the base for the video telephone 1, includes a further series of operative components including a microphone 8 for receiving audio signals, a keypad 9 for entering the various numbers associated with operations of the video telephone 1, and a series of function control keys 10 for facilitating operations of the video telephone 1, as will be discussed more fully below. Additionally provided for the convenience of the user is a window 11 for noting information such as commonly used telephone numbers, or other information commonly used in the course of operating the video telephone 1. A recess 12 is provided to receive the camera 5 when the video telephone 1 is closed.

As with the outer configuration for the video telephone 1, it will be understood that the configuration shown in Figure 1, and the specific placements shown for the several operative components which comprise the video telephone 1 (including the camera 5, the speaker 6, the video display 7, the microphone 8, the keypad 9, and the function control keys 10), and for the convenience features associated with the video telephone 1 (such as the window 11), represents only one of a variety of configurations for conveniently locating these various components. The locations for, and the combinations of these various components may be varied freely, according to need and as desired.

In operation, the user of the video telephone 1 will be comfortably and conveniently positioned in front of the camera 5 and the video display 7, so that the camera 5 can acquire images of the user and so that the user can conveniently view the video display 7. Audio (voice) signals can be exchanged making use of the speaker 6 and the microphone 8. In accordance with the present invention, it has been found to be preferable to position the user approximately 2 feet from a 4 inch display monitor, to optimize use ("filling") of the screen while minimizing potential adverse effects such as "pixelization" and "blockiness".

Referring to Figure 3, necessary connections for the video telephone 1 are preferably received along the rear face 13 of the bottom half section 3. This includes a connector 14 for mating with the corresponding connector (not shown) of an appropriate power supply (i.e., an AC adapter), and a jack 15 for connection with the telephone line over which the video telephone 1 will communicate. Additional jacks 16 are provided for communicating with other equipment which may be present at the user's premises (for example, a conventional telephone, a telephone answering machine, a caller identification unit, etc.), and additional connectors 17 are provided for making external audio and external video connections, if desired.

The connector 14 can communicate with any conventional power supply, and an on-off switch 18 is provided (see Figure 2) for overall control of the power supply which is used. The jacks 15, 16 used to connect the video telephone 1 with the external telephone line, and possibly with other equipment, may be any of a variety of conventional jacks, including the commonly used RJ-11 jacks shown. The connectors 14, 17 may also be any of a variety of conventional connector types. While it is preferred to place the connectors 14, 17 and the jacks 15, 16 along the rear face 13 of the video telephone 1, and to place the

switch 18 along the side 19 of the video telephone 1, as shown in the drawings, other placements of such components are equally possible, if desired.

Figure 4 shows a circuit 20 for implementing the various functions of the video telephone 1, which is preferably configured to conform to the following specifications. The video telephone 1 is compatible with an H.324 Video Phone Standard, with a compression/decompression routine in accordance with an H.263 Standard. Error detection/correction is achieved in accordance with an H.221 Standard, and compressed audio data is multiplexed with the compressed video data in accordance with an H.242 Standard. The video telephone 1 preferably uses a 33.6 Kbits/sec integral modem compatible with V.34 operation. The display is transmitted with selectable resolutions of 160 X 128, QCIF (176 X 144), or CIF (352 X 288) color pixels. The display is preferably capable of operating at up to 15 frames per second, depending on picture size, image motion, audio activity and telephone line quality.

In terms of its interface with a switched telephone network, the video telephone 1 is preferably made capable of interfacing with a standard (POTS) analog telephone line, with a telephone/modem compatibility which is V.34 compliant (at 33.6 Kbits/sec), and developing a combined data and voice data stream which is in compliance with United States Regulations (FCC), Part 68 and 15, DOC Standards.

In order to be portable, and self-contained, the video telephone 1 contains a complete complement of video telephone circuitry required to operate as an independent system, for use with any standard telephone line. To this end, the video telephone 1 preferably includes a series of functions and features capable of providing a selectable self image, remote image or picture-in-picture (PIP) display, mute and self image transmission controls, keypad dial operation with memory and redial functions, full duplex (hands free) speaker phone operation, with volume control,

video quality versus frame rate control, telephone line quality transmission rate compensation, voice only telephone operation, a backlit AM TFT LCD (Active Matrix Thin Film Transistor Liquid Crystal Display) module (for night operation) with contrast and color adjustment, a CCD (Charge Coupled Device) camera with electronic shutter control, and auxiliary audio and video input and output capabilities. A detailed description of the principal components of the circuit 20 which provide these capabilities follows, with further reference to Figure 4 of the drawings.

A microcontroller subsystem 21 serves as a primary user control interface, and is preferably implemented with an Intel, 80C32 single chip microprocessor, or an equivalent circuit component, in conjunction with PROM 22, RAM 23, EEPROM 24 and a keypad interface 25. The microcontroller subsystem 21 operates to control all video telephone functions including setup and control of the video coder/decoder (codec) and communications controller, the control of all video input parameters, the control of all video output parameters, the control of all audio codec parameters, the control of all modem parameters and the interpretation of telephone keypad commands and control switches. The software needed to implement the several functions of the microcontroller subsystem 21 will tend to vary with the specific functions that are made available for a particular configuration of the video telephone 1 (based on user need and unit cost), and can be implemented using programming methods that are otherwise known in the industry.

A video codec and communications controller 26 is preferably implemented with an Analog Devices, ADSP-21062 DSP, or an equivalent circuit component. This DSP is a 32-bit floating point processor based on Super Harvard Architecture, which operates in conjunction with two banks of flash memory 27, 28, and SRAM 29. The video codec and communications controller 26 can operate with 40 MIPS

instruction execution and 80 MFLOPS sustained performance, with 10 DMA channels, and performs the functions of video compression and decompression (in accordance with an H.263 Standard), pre-processing and post-processing functions including video scaling, temporal filtering, output interpolation and color conversion, error detection and correction (in accordance with an H.221 Standard), multiplexing and demultiplexing of the video data and audio data bit streams (in accordance with an H.242 Standard) and controls the operation of the audio and video DSP's, and the video capture and video output circuits. The video codec and communications controller 26 is further preferably supported by SRAM 29 and flash memory 27, 28 for program storage, and includes the (vendor-supplied) software necessary for its operation. Dual flash memory 27, 28 is provided so that software can be downloaded to one bank of flash memory while the remaining bank of flash memory continues to permit ongoing operation of the video telephone 1 during the downloading procedure (e.g., to provide updates or for field operations). Communications between the microcontroller subsystem 21 and the video codec and communications controller 26 are preferably implemented with dual port RAM 30.

A modem DSP 31 communicates with the video codec and communications controller 26, and is preferably implemented with an Analog Devices, ADSP-2185 DSP, or an equivalent circuit component. This DSP has a 16-bit fixed point architecture, and is capable of providing 33 MIPS sustained performance (with 80 Kbytes of on-chip RAM) and 16-bit DMA channels. The modem DSP 31 executes a program (vendor-supplied) that provides V.34 modem operation, and which is downloaded from flash memory 27, 28.

An audio DSP 32 additionally communicates with the video codec and communications controller 26, and is again preferably implemented with an Analog Devices, ADSP-2185 DSP, or an equivalent circuit component. The audio DSP 32

performs the functions of audio compression and decompression (in accordance with a G.723 Specification), and provides full duplex speaker phone operation (with echo cancellation). The audio DSP 32 again executes a program (vendor-supplied) that is downloaded from flash memory 27, 28.

The modem DSP 31 and the audio DSP 32 communicate with an audio codec 33, which provides analog-to-digital (ADC) and digital-to-analog (DAC) conversion of the audio signals. The audio codec 33 is preferably implemented with an Analog Devices AD1843, or an equivalent circuit component, and provides for plural audio input and audio output channels, and fully programmable gain and attenuation. The audio codec 33 performs the functions of digitizing the microphone input (in conjunction with an amplifier 34) and the auxiliary audio inputs which are provided to the audio DSP 32, digitizing the received telephone line input (with the telephone DDA 35) which is provided to the modem DSP 31, converting the output of the audio DSP 32 to an analog signal (with the amplifier 36) for driving the speaker 6 and any auxiliary audio associated with the jacks 15, and converting the output of the modem DSP 31 to an analog signal for driving the output (transmit) to the telephone line.

The telephone line interface will be compliant with the applicable sections of FCC Regulations, Part 15 and Part 68. To this end, a fully compliant data access arrangement hybrid module provided by Xecom is preferably used in the telephone line interface circuit. As a result, the video telephone 1 can provide full pass-through operation of the telephone line to either a data modem or a local dial telephone. This allows for normal deskset telephone operation to continue even when the video telephone 1 is not in use.

The video codec and communications controller 26 also communicates with a video (input) capture circuit 37, which

is preferably implemented with a Brooktree, BT819, or an equivalent circuit component, supported by SRAM 38 and suitable control and timing logic provided in an FPGA. The capture circuit 37 is controlled directly, by the video codec and communications controller 26 (DSP). However, such controls can also be accessed by the microcontroller subsystem 21, if desired. The video capture circuit 37 operates to capture frames of NTSC video input provided by the camera 5 (preferably a CCD camera), and converts and scales the captured frames to digital data for use by the video codec and communications controller 26. The captured frames are then temporarily stored in SRAM 38 associated with the capture circuit 37.

The video codec and communications controller 26 also communicates with a video output circuit 39. The video codec and communications controller 26 provides a digital YUV data stream for the image to be displayed (on the TFT LCD display 7). The image provided must be scaled to a full screen image, and converted to NTSC format, to be compatible with the LCD display. Such scaling is accomplished at 40, preferably with a C-Cubed, MVP133 video scaler, or an equivalent circuit component, which takes a QCIF format image from the video codec and communications controller 26 and places the formatted image in associated video memory (RAM 41). The image is then scaled up to a full display size, and output as YUV digital data. The digital output of the video scaler 40 can then be provided to a video converter 42, which is preferably implemented with an Analog Devices, AD7176, or an equivalent circuit component. Such a device is capable of taking 16-bit digital data and creating the analog NTSC signals required to drive an LCD display module.

A preferred display 7 for use in accordance with the present invention is a Unipac, UP461C, color TFT LCD module. A preferred camera 5 for use in accordance with the present invention is a Sanyo, SES3402, color CCD camera module. In

each case, suitable equivalent devices can be used if desired.

Set-up of the video telephone 1 only requires connection of the unit to an available telephone line, which is accomplished using the appropriate jack 15 (i.e., a standard RJ-11 connection), and connection of the appropriate power supply (i.e., an AC adapter) to a power source (e.g., a wall outlet), using the connector 14. If desired, the video telephone 1 can further be connected to an optional, standard telephone (using the appropriate jack 15), for normal use of the telephone line when the video telephone 1 is not being used.

Upon its initial operation, the video telephone 1 preferably assumes a series of default operating parameters that are programmed into the microcontroller subsystem 21. This can include parameters for regulating features of the video telephone 1 including local and remote image display, image quality versus frame rate setting, default LCD settings (color, contrast, brightness), default audio settings (volume, microphone sensitivity), default modem settings (default bit rate) and default answer modes. These parameters are then stored by the microcontroller subsystem 21 in EEPROM 24. Such parameters can then be modified using the keypad 9 and the function control keys 10, to suit the preferences of the user.

Typical operation of the video telephone 1 would be initiated by turning on the power switch 16. At this point, a self-image (of the user seated in front of the video telephone) would preferably appear on the LCD display 7. The keypad 9 is then used to enter a telephone number, or the function control keys 10 are used to recall a number from memory or for redialing a previously dialed number. The desired call is then initiated through the conventional, switched telephone network, to the video telephone of a selected recipient. Once this desired connection is established, the remote image then appears on the LCD

display 7. Additional function control keys 10 are provided that allow the caller to control the various operating parameters associated with the video telephone 1.

This results in a video telephone 1 that operates in virtually the same way as a conventional full duplex telephone, using a conventional telephone line (POTS analog). The video telephone 1 is further made portable as a result of such features (weighing on the order of 3 pounds or less). Connection of the video telephone 1 to the switched telephone network is simply performed, using standard RJ-11 connectors and cables, and the connected unit is then capable of operating either as a conventional telephone, or as a video telephone, as desired. Since the video telephone 1 utilizes a single, voice grade channel, neither the resulting line charges nor the use charges will be burdened with any premium charges when video images are added to conventional voice transmission. As a result, the cost of a video telephone call will be the same as a voice call.

In operation, the video telephone 1 is capable of displaying both remote and local images, and the images produced are capable of convenient adjustment to suit the surroundings of the displayed images, and the preferences of the user. Similar adjustments are made available for the associated audio signals. Any of a number of ancillary, convenience features may be provided, if desired, including single-button speed dialing, memory dialing, speaker-phone operation, privacy calling (where the caller cannot be seen), head-set operation, automatic answering, picture-in-picture operation (including simultaneous self-view and caller view), LCD telephone number display and the storage of telephone numbers, names and addresses.

It will further be understood that various changes in the details, materials and arrangement of parts which have been herein described and illustrated in order to explain the nature of this invention may be made by those skilled in

the art within the principle and scope of the invention as expressed in the following claims.

CLAIMS

1. A video telephone comprising:

an outer case including a mated pair of half sections connected by a hinge, wherein the mated pair of half sections are movable between a closed position in which the half sections combine to define a box-shaped enclosure and an open position which exposes interior portions of the enclosure;

a video camera and a video display associated with the interior portions of the enclosure, which combine to develop video images for the video telephone;

a microphone and a speaker associated with the interior portions of the enclosure, which combine to develop audio signals for the video telephone;

a keypad associated with the interior portions of the enclosure, which provides a user interface for the video telephone; and

an electrical circuit coupled with the video camera, the video display, the microphone, the speaker and the keypad, wherein the electrical circuit provides functions of the video telephone including transmission and reception of audio and video images using a standard telephone line.

2. The video telephone of claim 1 wherein one of the half sections is a cover for the video telephone, when in the closed position, wherein another of the half sections is a base for the video telephone, and wherein the cover is movable relative to the base.

3. The video telephone of claim 2 wherein the video camera, the video display and the speaker are associated with the cover of the video telephone.

4. The video telephone of claim 2 wherein the

microphone and the keypad are associated with the base of the video telephone.

5. The video telephone of claim 4 which further includes a plurality of function control keys associated with the base of the video telephone.

6. The video telephone of claim 1 wherein the video telephone is an integral, stand-alone unit.

7. The video telephone of claim 1 wherein the video display operates at a rate of up to 15 frames per second.

8. The video telephone of claim 1 wherein the video telephone communicates with a standard (POTS) analog telephone line.

9. The video telephone of claim 1 wherein the video telephone further includes a selectable self image and remote image display.

10. The video telephone of claim 9 wherein the video telephone further includes a picture-in-picture (PIP) display.

11. The video telephone of claim 1 wherein the video telephone further includes mute and self-image transmission controls.

12. The video telephone of claim 1 wherein the video telephone further includes keypad dial operation having memory and redial functions.

13. The video telephone of claim 1 wherein the video telephone further includes a full duplex speakerphone.

14. The video telephone of claim 1 wherein the video telephone further includes a video quality versus frame rate controller.

15. The video telephone of claim 1 wherein the video telephone further includes a telephone line quality transmission rate compensator.

16. The video telephone of claim 1 wherein the video telephone further includes auxiliary audio and video input and output capabilities.

17. The video telephone of claim 1 wherein the video telephone further includes a mode for providing telephone operations limit to voice transmission.

18. The video telephone of claim 1 wherein the video display is a backlit active matrix thin film transistor liquid crystal display.

19. The video telephone of claim 1 wherein the video camera is a charge coupled device.

20. The video telephone of claim 1 wherein the electrical circuit includes a complementary pair of memory devices, and wherein one of the memory devices receives data from an external source while another of the memory devices continues operation of the video telephone.

21. A method for operating a video telephone including an outer case having a mated pair of half sections connected by a hinge, wherein the mated pair of half sections are movable between a closed position in which the half sections combine to define a box-shaped enclosure and an open position which exposes interior portions of the enclosure, a video camera and a video display associated with the

interior portions of the enclosure, which combine to develop video images for the video telephone, a microphone and a speaker associated with the interior portions of the enclosure, which combine to develop audio signals for the video telephone, and a keypad associated with the interior portions of the enclosure, which provides a user interface for the video telephone, wherein the method further comprises the steps of:

connecting the video telephone to a standard telephone line and to an external power source;

opening the half sections of the video telephone, exposing internal components of the video telephone including the video camera, the video display, the microphone, the speaker and the keypad; and

dialing a conventional telephone number of a recipient, establishing a video telephone connection with the recipient, wherein the video telephone connection establishes two-way video telephone communications with the recipient.

22. The method of claim 22 wherein the electrical circuit includes a complementary pair of memory devices, and wherein the method further includes the steps of receiving data from an external source in one of the memory devices while continuing operation of the video telephone using another of the memory devices.

23. The method of claim 22 wherein the display is a 4 inch monitor, and wherein the method further includes the step of positioning a user of the video telephone about 2 feet from the monitor.

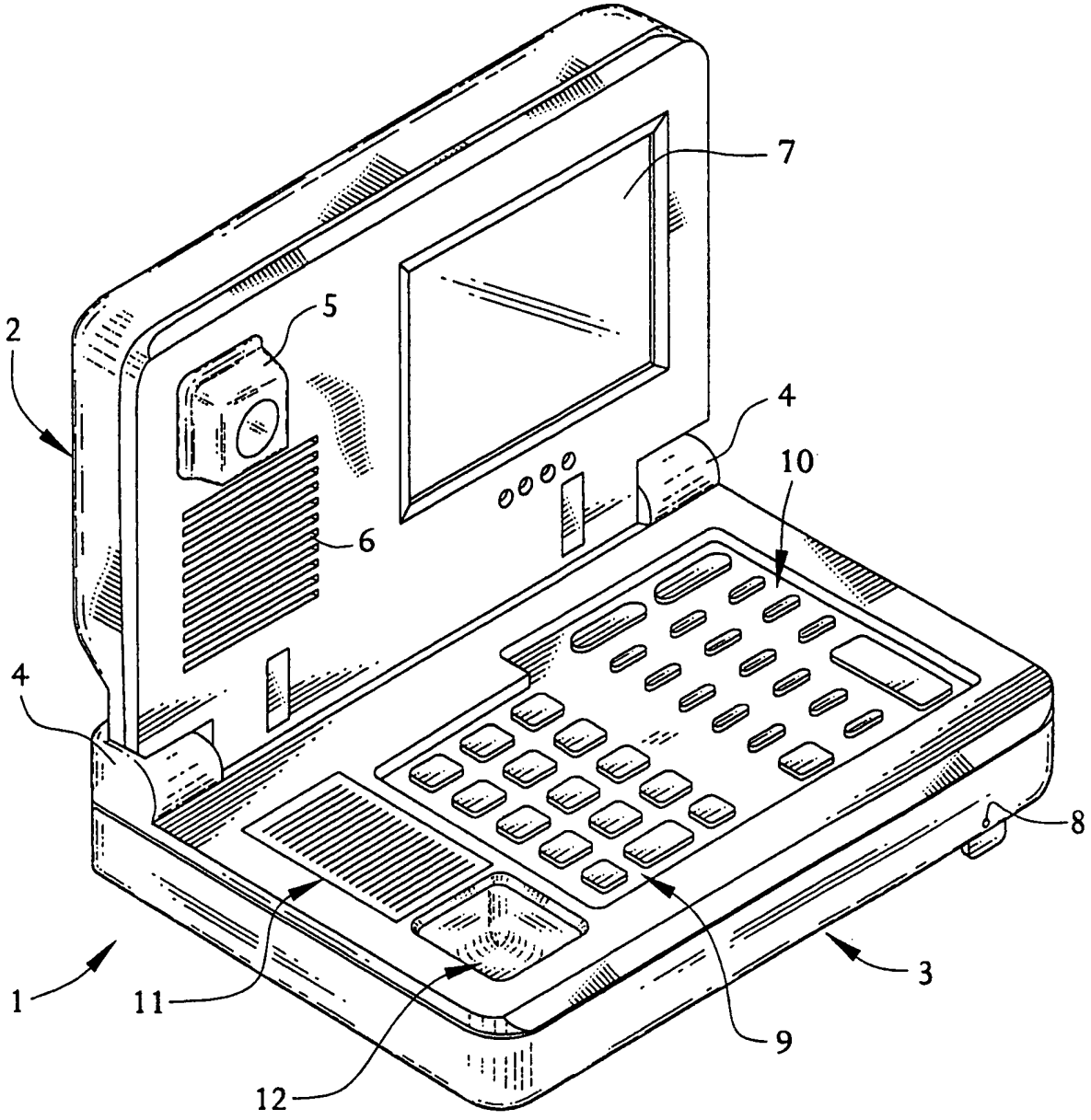

FIG. 1

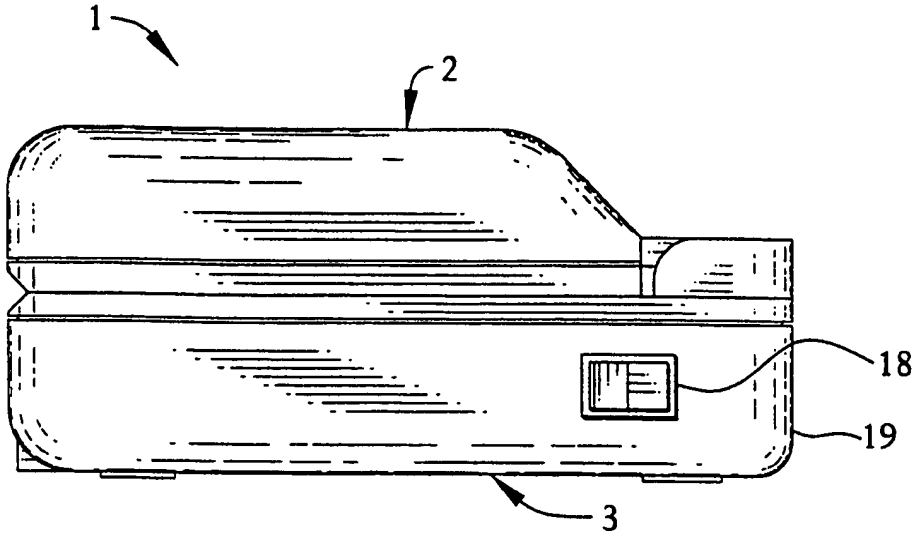

FIG. 2

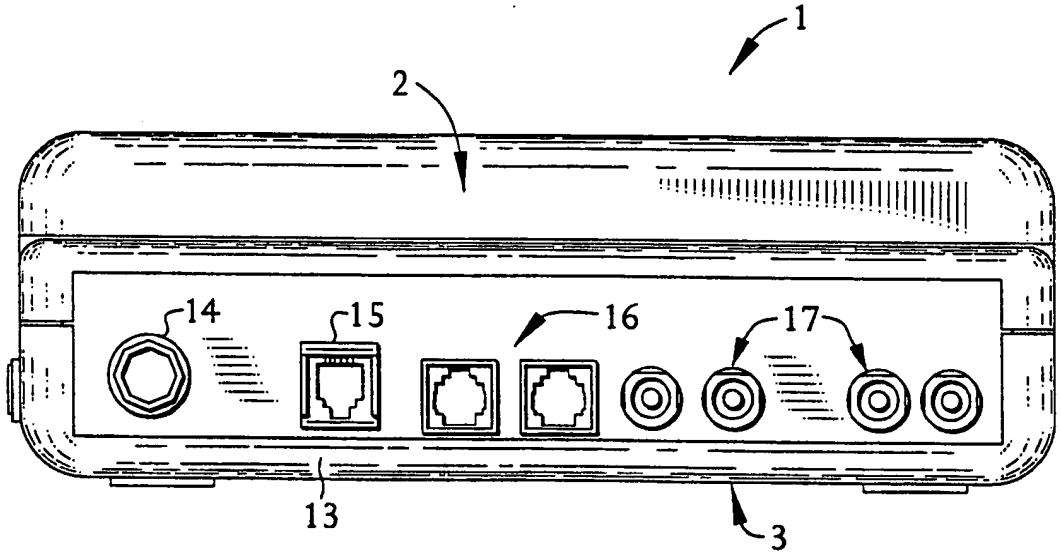

FIG. 3

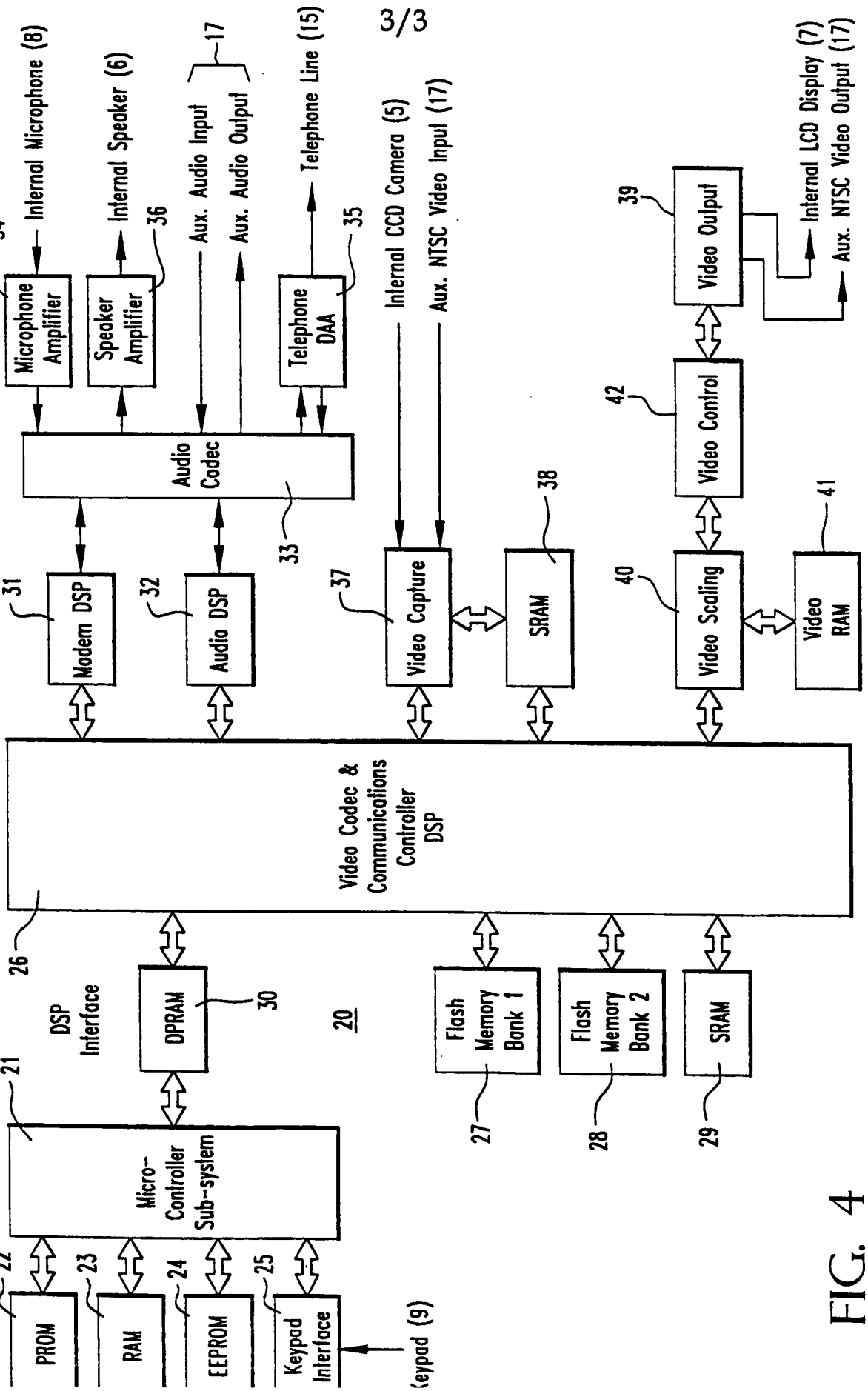
Internal Microphone (8)
Internal Speaker (6)
Aux. Audio Input
Aux. Audio Output
17
Telephone Line (15)
34
36
35
Microphone Amplifier
Speaker Amplifier
Telephone DAA
Audio Codec
33
Internal CCD Camera (5)
Aux. NTSC Video Input (17)
39
Video Output
Internal LCD Display (7)
Aux. NTSC Video Output (17)
42
Video Control
38
41
31
32
37
40
Modem DSP
Audio DSP
Video Capture
SRAM
Video Scaling
Video RAM
Video Codec & Communications Controller DSP
26
DSP Interface
DPRAM
30
20
Flash Memory Bank 1
Flash Memory Bank 2
SRAM
27
28
29
21
Micro-Controller Sub-system
22
23
24
25
PROM
RAM
EEPROM
Keypad Interface
Keypad (9)

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/27618

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : H04N 7/14
US CL : 348/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/14, 15, 15, 17,18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,258,387A (LEMELSON et al. 24 MARCH 1981, entire patent.	1-9, 11, 13, 17, 19, 21, 23 ---------- 10, 12, 14-16, 18, 20, 22-23
X --- Y	US 5,389,965 A (KUZMA) 14 FEBRUARY 1995, Figs. 1, See abstract, col. 8 lines 13-68, col. 9 lines 1-23, col. 13 lines 13-19.	7 -------- 14, 15
Y	US 5,477,546 A (SHIBATA et al.) 19 DECEMBER 1995, fig. 4, col. 9 lines 44-51	10
Y	US 5,587,735 A (ISHIDA et al.) 24 DECEMBER 1996, FIG. 5 , col. 4 lines 54-68, col. 5 lines 1-33.	12, 16

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
04 FEBRUARY 1999	20 APR 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT	Authorized officer MELUR RAMAKRISHNAIAH

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,193,018 A (WU) 09 MARCH 1993, FIG. 3 col. 3 lines 11-22,	18
Y	US 5,339,430 A (LUNDIN et al.) 16 AUGUST 1994, fig. 6 col. 12 lines 13-50.	20, 22